Chapter 22
Low-Temperature/High-Temperature Thermal Desorption

22-1. General

The processes, applications, and limitations of low-/high-temperature thermal desorption are described in the chapter's first section. The second portion of the chapter is a hazard analysis with controls and control points listed.

22-2. Technology Description

a. Process.

Low- and high-temperature thermal desorption treat wastes by vaporizing water and organic compounds from the feed solids, such as soils (see Figure 22-1). In contrast to incineration processes, these are physical separation methods and are not designed to directly destroy organic compounds. Consequently, they operate at lower temperatures than incineration. In practice, the off-gas that is laden with the evaporated contaminants is often incinerated in higher temperature, smaller, and more economical secondary burners or incinerators. The off-gas contaminants can also be condensed for disposal or reuse. The terms low- and high-temperature thermal desorption are somewhat arbitrary classifications, as most units can operate across a range of temperatures. High- and low-range systems overlap considerably in capability.

Two common thermal desorption systems are the rotary dryer and thermal screw. Rotary dryers are horizontal cylinders that are inclined and rotated during firing. Thermal screw units utilize screw conveyors or hollow augers to transport the medium through an enclosed trough. Hot oil or steam circulates through the auger to indirectly heat the medium. When utilizing either system, particulates generated during desorption are removed by wet scrubbers, cyclones, electrostatic precipitators, or bag house (fabric) filters. Volatile contaminants are purged with a carrier gas or vacuum system and are removed through condensation followed by carbon adsorption, or they are destroyed in a secondary combustion chamber or catalytic oxidizer. Often the treated medium is returned to the excavation after testing. Both systems are available as transportable units that can be brought to sites.

b. Applications.

Low-temperature thermal desorption systems are effective for the removal of both non-halogenated and halogenated volatile organic compounds (VOCs) and petroleum hydrocarbons. Semi-volatile organic compounds (SVOCs) can be treated with reduced effectiveness. Soil decontaminated with a low-temperature thermal desorption system retains its physical properties.

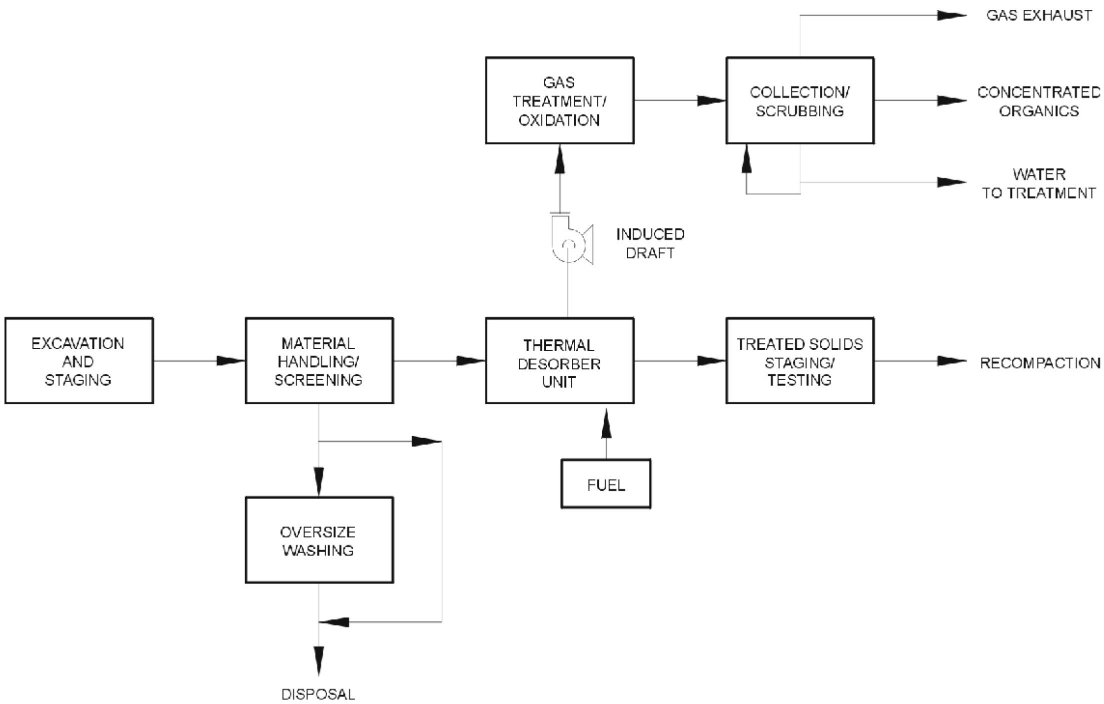

FIGURE 22-1. TYPICAL PROCESS FLOW FOR LOW-TEMPERATURE/ HIGH-TEMPERATURE THERMAL DESORPTION

High-temperature thermal desorption systems are effective for the removal of VOCs, SVOCs, polycyclic aromatic hydrocarbons (PAHs), such as coal tar wastes, creosote-contaminated soils, or polychlorinated biphenyls (PCBs), pesticides, paint wastes, and mixed (radioactive and hazardous) wastes. Volatile metals may be removed by high-temperature thermal desorption systems. Soils treated with high-temperature thermal desorption may lose many of their soil properties and may need to be amended if expected to provide structure.

c. Limitations.

Limitations are similar in both systems. Dewatering of the feed soils may be required to reduce the amount of energy required to heat the soil in both the low- and high-temperature thermal desorption systems. Clay and silt-based soils or high humic content soils may increase the required residence times because of binding of organic constituents. Heavy metals in the soil may produce a residue that requires stabilization prior to returning it to the excavation. Feed particle size limitations can affect applicability and cost for specific soil types, and abrasive feed streams may damage the processor unit.

22-3. Hazard Analysis

Principal unique hazards associated with low/high-temperature thermal desorption, methods for control, and control points are described below

a. Physical Hazards.

(1) *Noise Hazards*.
Description. Desorption treatment units may expose workers to elevated noise levels in the work area from the operation of air blowers, pumps, induced draft fans, high energy venturi scrubbers, fuel injection ports, and the ignition of fuels within the combustion chamber. Noise may interfere with safe and effective communications.

Control. Controls for noise hazards include:

- Follow the regulatory requirements of CEGS 02289, "Remediation of Contaminated Soils by Thermal Desorption."
- Train workers in the use of hearing protection and establish a hearing protection program (see 29 CFR 1910.95).
- Use hearing protection with appropriate NRR hearing protectors selected to eliminate the noise hazard without overprotecting, thus potentially preventing necessary voice communications.
- Use personal electronic communications devices, such as a dual ear headset with speaker microphone, to overcome ambient noise. The device reduces ambient noise levels while enhancing communication. Hearing protection and headset combinations are available commercially and should be used where needed.
- Establish vibration and noise-free areas during operations to provide breaks from the vibration and noise, which can cause fatigue and inattention.

CONTROL POINT: Design, Operations

(2) *Fire or Explosion (System Design).*
Description. Thermal desorption units, including the thermal desorbers and high temperature air pollution control systems such as bag houses located between the rotary drum and the afterburner units, can create a fire or explosion hazard owing to flammable hydrocarbon condensation onto the bag filters within the bag house. The accumulation of the condensed flammable hydrocarbons can be rapid or gradual, depending on contaminant type and concentration within the soil being treated.

Control. Controls for fire and explosion include:

- Operate the unit following the instructions in UFGS 02181A, "Remediation of Contaminated Soils by Thermal Desorption." This standard, in part, requires:
- A Startup Plan.
- A Proof of Performance Plan listing the proposed operating conditions for process parameters to be continuously monitored and recorded.
- An Operating Plan specifying detailed procedures for continued operation of the system, based on the proof of performance results.
- A Demobilization Plan.

- If practical, design parallel flow plants that include the particulate filter system as the final phase of the treatment process to eliminate the danger of condensation of VOCs within the bag house.
- If practical, destroy the VOCs before the gases enter the bag house, increasing the life of the bag filters and eliminating the potential for bag house fires.
- Routinely and safely inspect for condensation buildup and periodically replace bag filters. Condensation is a function of vapor pressures of the contaminants, which is directly related to concentration. As concentration increases, the gas temperature required to maintain the vapor state must increase to avoid condensation.
- Train the operators in emergency procedures in the event of a catastrophic failure, in life saving first aid procedures including halting the thermal reactions, extracting, extinguishing, decontaminating and stabilizing victims, and in emergency system isolation and shutdown procedures.
- Locate emergency fire fighting equipment, eyewashes, and showers at critical points throughout the system. (See American National Standards Institute ANSI Z358.1 – 1998.)
- Perform a Process Hazard Analysis (PHA) prior to initial startup and correct all deficiencies found.

CONTROL POINT: Design, Operations, Maintenance

(3) *Fire or Explosion (High Operating Temperatures).*
Description. Thermal desorption units, including the thermal desorbers and high temperature air pollution control systems, such as electrostatic precipitators or bag houses with associated high temperature ventilation duct ash transfer systems that are operated above the ASTM E953 (R1998) “Standard Test Method for Fusibility of Refuse-Derived Fuel (RFD) Ash”-determined ash fusion temperature, may cause the solid waste material to build up or vitrify into a large, hot mass within the unit. The resulting heat and pressure buildup may exceed the equipment pressure rating of the unit, possibly causing a fire or explosion or release of hot ash or vitrified waste materials and gases during operation or maintenance procedures that require opening or entering the units.

Control. Controls for fire and explosion include:

- Operate the unit following the instructions in UFGS 02181A, “Remediation of Contaminated Soils by Thermal Desorption.” This standard, in part, requires:
- A Startup Plan.
- A Proof of Performance Plan listing the proposed operating conditions for process parameters to be continuously monitored and recorded.
- An Operating Plan specifying detailed procedures for continued operation of the system, based on the proof of performance results.
- A Demobilization Plan.

- Permit-required confined-space entry plan, including pre-entry unit shutdown and temperature verification prior to doing maintenance on the unit openings or interiors.
- Train the operators in emergency procedures in the event of a catastrophic failure, in life saving first aid procedures including halting the thermal reactions, extracting, extinguishing, decontaminating and stabilizing victims, and in emergency system isolation and shutdown procedures.
- Locate emergency fire fighting equipment, eyewashes, and showers at critical points throughout the system. (See ANSI Z358.1 – 1998.)
- Perform a Process Hazard Analysis (PHA) prior to initial startup and correct all deficiencies found.

CONTROL POINT: Design, Operations, Maintenance

(4) *Flammable/Combustible Fuels*.
Description. Thermal desorption usually requires storage of flammable or combustible fuels used to fire the thermal desorber (e.g., kerosene, waste fuels). Hazards associated with fuels include the potential for on-site spills or release of material. The release may cause worker exposure to the vapors generated, or a fire hazard may exist if the material is ignited.

Control. Controls for flammable/combustible fuels include:

- Use appropriate tanks, equipped with pressure-relief devices and bermed to help prevent release of material.
- Use electrical equipment and fixtures that comply with NFPA 70.
- Follow UFGS 02181A, "Remediation of Contaminated Soils by Thermal Desorption." It requires that fuel system installation/storage/testing comply with NFPA 30, "Flammable and Combustible Liquids Code," NFPA 31, "Installation of Oil Burning Equipment," NFPA 54, "National Fuel Gas Code," or NFPA 58, "Standard for the Storage and Handling of Liquefied Petroleum Gases."
- Ventilate the area adequately to help prevent the accumulation of flammable vapors.
- Authorize only trained and experienced personnel to work on the system.
- Use lock-out and tag-out procedures on all electrical systems during repair or maintenance.

CONTROL POINT: Design, Construction, Operations, Maintenance

(5) *Ignition of Saturated Soils*.
Description. During excavation of waste materials with low flash points, saturated soils may be ignited by sparks generated when the blade of the dozer or crawler contacts rocks or other objects under unusual or extraordinary conditions. If the soil will be crushed prior to feeding into the desorption unit, waste materials with higher than expected Btu values may ignite during the crushing/sorting process.

Control. Controls for ignition of saturated soils include:

- Apply water periodically to the soils (before and during crushing).
- Equip soil-handling equipment with non-sparking buckets or blades when highly flammable excavation materials are suspected.

CONTROL POINT: Operations

(6) *Fire or Explosion (High-Btu Feed).*
Description. If the Btu value of the waste feed is not controlled and high-Btu feed enters the thermal desorber unit, the temperature of the unit may exceed design specifications, possibly resulting in fire or explosion. If the concentration of the soil contaminants is high enough to create a VOC concentration in the gas stream exceeding the Lower Explosive Limit (LEL) in and throughout the thermal treatment unit, the mixture creates a potential for fire or explosion.

Control. Controls for fire include:

- Use experienced operators and supervisors.
- Audit and apply proper quality assurance/quality control (QA/QC) to assure that the unit is operating according to design and that the waste feed has a consistent Btu value based on design parameters.
- Design a gas volume based on the contaminant levels of the soil that exits in the rotary drum of the thermal treatment unit, producing a waste gas stream not exceeding 25% of the LEL for the contaminant. The greater the concentration of the soil contaminants, the greater is the volume of the gas stream exiting the rotary drum unit to maintain less than 25% LEL. In counter flow systems, where the exit gas temperature and, therefore, gas volume is fixed, the amount of feed contaminants must also be controlled to maintain the exit gas mixture to less than 25% LEL.
- Make the air within the thermal desorber inert and maintain this inert atmosphere throughout the treatment train during operation.
- Train the operators in emergency procedures in the event of a catastrophic failure, in life saving first aid procedures including halting chemical reactions, extracting, decontaminating and stabilizing victims, and in emergency system isolation and shutdown procedures.
- Locate emergency fire fighting equipment, eyewashes, and showers at critical points near the thermal desorber. (See ANSI Z358.1 – 1998.)
- Perform a Process Hazard Analysis (PHA) prior to initial startup and correct all deficiencies found.

CONTROL POINT: Design, Operations

(7) *Electrocution*.
Description. Because desorption treatment units operate electrical systems outdoors, workers may be exposed to electrocution hazards if the electrical equipment comes in contact with water or subunits are not properly grounded.

Control. Controls for electrocution include:

- Verify that drawings indicate the hazardous area classifications as defined in NFPA 70, Chapter 5, section 500.1 through 500.10.
- Use controls, wiring, and equipment with adequate ground-fault protection that meet the requirements of EM 385-1-1, Section 11, and NFPA 70.
- Perform all electrical work in accordance with applicable codes and under the supervision of a state licensed master electrician.
- Never allow the use of ungrounded, temporary wiring during small maintenance work on the units, or grounded, temporary wiring in contact with water, wet, or damp surfaces that is not approved for those applications.

CONTROL POINT: Design, Construction, Operations, Maintenance

(8) *Thermal Desorber Operation.*
Description. Workers may be exposed to toxic waste chemicals or exhaust gases via inhalation exposures if high-Btu waste material is fed into the thermal desorber at a rate that exceeds its design capacity. The heat and excessive exhaust gases may over-pressurize the system, resulting in a release of both combustion gases and unburned or partially burned waste material vapors into worker areas.

Control. Controls for incinerator operation include:

- Use experienced operators and supervisors.
- Audit and apply proper QA/QC to assure work is done as designed.
- Operate the system and waste material within design parameters.

CONTROL POINT: Design, Operations

(9) *Thermal Desorption System Design*.
Description. The thermal desorption process can be one piece of equipment with several exhaust gas treatment units in a treatment train following the thermal desorption unit. There may be exhaust gas conditioning equipment, such as electrostatic precipitators, bag houses, vapor scrubbers, and catalytic converters. Each piece of equipment has its own associated hazards; one example is the ever-present hazard of confined space entries to workers required to enter units for maintenance or repair. The EPA regulates the basic design requirements for thermal desorbers. Both the manufacturers and EPA specify design requirements to eliminate contaminant releases that may cause personnel or public exposures, and are also specified for assuring safe operation and maintenance.

Control. Controls for the thermal desorber system designs include:

- Design toxic and exhaust emission control to address all the individual subsystems in the overall system.
- Design the thermal desorber process according to EPA and manufacturer requirements. Consult OSHA standard 29CFR1910.146 “Permit-required Confined Spaces” to reduce to a minimum, the number of confined spaces designed into the system. Designers should also consult the requirements of

UFGS 02180A, "Remediation of Contaminated Soils and Sludges by Incineration."

(10) *Transfer Equipment Design*.
Description. All transfer equipment (conveyors, piping, process units, and instruments) in contact with contaminated materials should be fabricated from materials that are chemically resistant to the given contaminant chemical. Improperly designed systems can corrode or dissolve, causing damage to the facilities or exposing workers to collapse hazards from falling equipment.

Control. Controls for transfer equipment include:

- Consult EM 1110-1-4008, "Liquid Process Piping," and UFGS 15200, "Liquid Process Piping," for appropriate materials for pumping various fluids.
- Use equipment fabricated from materials that are chemically inert to contaminants in the system.
- Install spill or leak detection instruments if necessary.
- Include containment drip pans or receivers for potential leaks and spills.
- Implement preventive maintenance program and complete periodic inspections.

CONTROL POINT: Design, Construction, Maintenance

(11) *Thermal Hazards*.
Description. The thermal desorption process uses high temperatures to heat treated materials and subunit equipment. The equipment, gasses generated, and processed materials may expose workers to possible thermal burn hazards.

Control. Controls for burns include:

- Design the thermal desorber and post-desorber treatment units to maximize ease of operation, physical cleaning, and maintenance to include adequately sized and easily accessible doors and ports where entry is required.
- Perform manufacturer recommended shutdown and cool-down procedures prior to working on, around, or entering the units.
- Use penetrating temperature probes to measure that internal temperatures of ash accumulations are ambient prior to entry into thermal treatment units to work.
- Develop and follow confined space entry permit and procedures and rigorously apply requirements.
- Verify function, and use manufacturer's temperature safety control systems.
- Post signs warning of high temperatures.
- Use safety barriers to isolate critical sections of the equipment.
- Design systems to handle the materials exiting the system. Follow NFPA 30, 31, and 54 and UFGS 02181A, "Remediation of Contaminated Soils by Thermal Desorption" criteria.

- Train workers in hazards, use heat resistant gloves and protective gear, and permit maintenance by workers only after process equipment has cooled to ambient temperatures.

CONTROL POINT: Design, Operations, Maintenance

(12) *Transfer Systems*.
Description. Transfer systems such as screw conveyors or augers expose workers to injury if limbs or clothing are caught in the system.

Control. Controls for transfer systems include:
- Enclose or otherwise guard transfer system pinch points such as belts, pulleys, and conveyor end points or material transfer points to the maximum extent possible.
- Install emergency shutoff controls at multiple critical locations and include the shutoff control locations and operation in all worker training.
- Enforce lock-out/tag-out procedures rigorously.
- Train workers in identification of pinch points in the system.

CONTROL POINT: Design, Operations, Maintenance

(13) *Piping System Leaks*.
Description. Workers may be exposed via the inhalation exposure route to VOCs, such as toluene, if leaks occur in the piping system.

Control. Controls for leaks in the piping system include:
- Appropriately size the system to maintain negative pressure (e.g., ducts and piping) at the maximum expected operating pressure.
- Avoid or minimize fugitive emission hazards by designing appropriate pressure control and relief systems.
- Install and test fuel systems according to requirements of NFPA 30, “Flammable and Combustible Liquids Code” NFPA 31, Installation of Oil Burning Equipment,” NFPA 54, National Fuel Gas Code,” or NFPA 58, “Standard for the Storage and Handling of Liquefied Petroleum Gases.”

CONTROL POINT: Design, Operations, Maintenance

(14) *Respirable Quartz*.
Description. Depending on soil type of the material thermally treated, exposure to respirable quartz may be a hazard. Consult a geologist to confirm the presence of quartz in feed materials (i.e., determine if soil type is likely to be rich in quartz). As an aid in determining respirable quartz exposure potential, sample and analyze site soils for fines content by ASTM D422 –2002: “Standard Test Method for Particle Size Analysis of Soils” followed by analysis of the fines by X-ray diffraction to determine crystalline quartz content.

Control. Controls for respirable quartz include:

- Eliminate airborne dust sources that penetrate workspaces, utilizing appropriate engineering controls. Construct water mist systems or implement local exhaust ventilation. Wet the soil periodically with water or amended water to minimize generation of airborne dust.
- Consult 29 CFR 1910.1000, Table Z-3, to calculate acceptable respirable dust concentrations based on percent silica in the quartz.
- Train workers on inhalation hazards of silica laden dust.
- Where engineering controls fail, provide appropriate respirators, medical screening, and associated employee training on use and limitations of respiratory protection, e.g., air-purifying respirators equipped with N, R or P100 particulate air filters. Verify appropriate use of respiratory protective equipment in identified hazardous work areas.

CONTROL POINT: Construction, Operations

(15) *Sunlight/UV Radiation*.
Description. During site activities, workers may be exposed to direct and indirect sunlight with its corresponding UV radiation. Even short-term exposure to sunlight can cause burns and dermal damage. Hot and humid conditions combined with radiant heat from process equipment can significantly contribute to the worker's heat load, thereby increasing the risk of heat injury, such as heat exhaustion, heat cramps, and heat stroke.

Control. Controls for Sunlight, UV radiation and heat stress include:

- Minimize direct sun exposure by wearing sun hats, long-sleeved shirts, full-length unbloused pants, and by applying UV barrier sunscreen to exposed skin. Loose clothing and sun hats should not be worn around moving parts that may snag the worker and draw him or her into a danger zone. All UV skin barrier creams should be pre-approved. Some creams contain zinc and other constituents that can cause false readings in analytical samples.
- Shade work and break areas, if possible.
- Minimize exposure to heat stress conditions by training the workers in the symptoms of heat stress, practicing the Buddy System, taking frequent breaks, drinking adequate fluids, and working during the cooler part of the day. Tasks with inherent heat stress risks should be identified and personal protective equipment (PPE) mandated. Heat stress levels and preventive measures as per accepted protocols shall be documented.
- Monitor for heat stress using the physiological or Wet Bulb Globe Temperature (WBGT) Index protocol provided in the most recent publication of the American Conference of Governmental Industrial Hygienists (ACGIH) "TLVs and BEIs: Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices."

CONTROL POINT: Construction, Operations

(16) *Electrocution Hazards*.

Description. Workers may be exposed to electrocution hazards when working around electrical utilities such as overhead power lines or underground cables with material handling equipment; or if electrical equipment on the thermal desorption units contact water or are not properly grounded.

Control. Controls for electrocution include:

- Verify the location of overhead power lines, either existing or proposed, in the pre-design phase through contacting local utilities.
- Verify the location of and do not disturb energized underground utilities during subsurface and excavation activities. Verify that drawings indicate the hazardous area classifications as defined in NFPA 70, 500-1 through 500-10.
- Use controls, wiring, and equipment that meet the requirements of EM 385-1-1, Section 11, and NFPA 70.
- Use adequate ground-fault protection.
- Keep equipment at least 10 feet from the power line according to Occupational Safety and Health Administration (OSHA) regulation 29 CFR 1926.550 and EM 385-1-1, Section 11.
- Never allow the use of ungrounded, temporary wiring for minor maintenance work on the units, or wiring not approved for contact with water, or on wet or damp surfaces.

CONTROL POINT: Design, Construction, Operations

(17) *Traffic Hazards*.
Description. During field activities, equipment and workers may come close to moving vehicular and equipment traffic. In addition the general public may be exposed to traffic hazards and the potential for accidents.

Control. Controls for traffic hazards include:

- Position controllers and spotters at critical points in the traffic flow to safely direct it.
- Post warning signs according to the criteria of the "Department of Transportation Manual on Uniform Traffic Devices for Streets and Highways."
- Develop a traffic management plan before remediation activities begin to help prevent accidents involving site equipment. EM 385-1-1, Section 21, provides plan details.

CONTROL POINT: Design, Construction, Operations

(18) *Heated Surfaces*.
Description. Workers may be exposed to infrared radiation hazards associated with working in the vicinity of thermal desorbing treatment units. The exposure, depending on the temperature of the equipment, length of exposure, and other variables may increase the risk of cataracts.

Control. Controls for heated surfaces include:

- Minimize worker exposure time on or near hot operating equipment surfaces.
- Use eye protection with the appropriate shade safety glass or reflective full body radiation (radiant heat) protective suits if prolonged work near the radiant heat surface or source is required.

CONTROL POINT: Operations, Maintenance

(19) *Confined Spaces.*
Description. Workers may be exposed to confined-space hazards during entry into the process equipment for repair, inspection, or maintenance in thermal treatment unit and associated subsystems, such as the thermal desorber itself, dust/gas collection/ventilation duct work, electrostatic precipitators, cyclones, high energy wet scrubbers, and bag houses. High temperature, oxygen deficient, toxic, inert, and negative air conditions may be encountered. The treatment train dust collection units typically operate at the high temperature generated in the thermal desorber. Ash and dust suctioned from the desorber can accumulate in the electrostatic precipitator (ESP), bag house, or cyclone feed duct and collection hoppers. Hot ash can retain its fluid and thermal properties for an extended period, even many days, after shutdown. Improper entry into confined spaces has resulted in serious injuries and death. Confined-space hazards may cause death or injury by sudden release of hot or vitrified waste ash or material in the units during maintenance, such as by prematurely opening hopper doors. Before entry, assurance must be made that no accumulations of ash are impounded behind the doors. Death or injury can be caused by inhalation exposure to heated inert gases, severe oxygen deficiency, toxic combustion byproducts or poisonous gases volatilized from the treated materials, which may include heavy metals, hydrogen sulfide (H_2S), carbon monoxide (CO), methane, and vinyl chloride, engulfment by hot ash, and entanglement or electrocution.

Control. Controls for confined spaces include:

- Design the thermal desorption treatment unit and exhaust gas treatment systems to maximize easy operation and physical cleaning and maintenance, to include accessible adequately sized access doors and ports, to minimize the number of confined spaces designed into the system, and to minimize the frequency, duration, and extent of cleaning and maintenance required.
- Develop a pre-entry confined space permit (see 29 CFR 1910.146).
- Test the atmosphere within the confined space prior to entry and monitor throughout the work (see 29 CFR 1910.146).
- Design air-handling systems to minimize or eliminate oxygen-deficient locations and rigorously ventilate prior to entry of personnel.
- Perform the manufacturer's shutdown procedures and lock-out/tag-out of electrically energized systems, such as for the ESP or bag house, prior to entry.

- Ash collection hoppers must be inspected internally from above to determine the buildup of ash in corners or valleys prior to opening hopper doors. The doors must be connected to the electrical interlock system for the ESP, bag house, or cyclone. Use hopper level indicators to ensure that no accumulation of ash is present behind hopper access doors. If the hopper must be entered, all ash must be dislodged and discharged prior to entry, e.g., use a mechanical vibrator, poke, prod or air lance followed by washing with high-pressure water hose. Hoppers must never be opened during operation of the collection unit because of ash temperature and fluidity.
- Use penetrating temperature probes to measure internal temperatures of ash buildup or piles, such as in dust collection unit hoppers, prior to opening or entering the units. Otherwise identify the locations of all accumulations of ash or vitrified ash in the units through soundings, measuring concentrations of background radioactive contaminants, or other means prior to entry.
- Use air-supplied respirators to control inhalation exposures to toxic chemicals and prevent any potential for asphyxiation where only constant mechanical ventilation prevents the build up of a toxic or inert gas environment.

CONTROL POINT: Design, Operations, Maintenance

(20) *Emergency Wash Equipment*.
Description. Emergency shower/eyewash equipment required per 29 CFR 1910.151 is not always provided with adequate floor drains, which results in creating potential electrical hazards or walking surface hazards during required testing and use.

Control. A control for emergency wash equipment includes:

- See American National Standards Institute ANSI Z 358.1 – 1998: “Emergency Eyewash and Shower Equipment” for design requirements.
- Equip showers/eyewash equipment with accompanying functional drains to isolate and collect the shower/eyewash water from unprotected electrical equipment and walking surfaces that, when wet, create slipping hazards.

CONTROL POINT: Design

(21) D*esign Field Activities*.
Description. Design field activities associated with subsequent construction may include surveying, biological, soil gas, and geophysical surveys, trenching, drilling, stockpiling, and contaminated groundwater sampling. Each of these field activities may expose the survey personnel to physical, chemical, radiological, and biological hazards.

Control. Controls for hazards resulting from design field activities include:

- Prepare an activity hazard analysis for design field survey activities. EM 385-1-1, Section 1, provides guidance on developing an activity hazard analysis.

- Prior to starting work, complete a walk-through inspection of each work zone with the intent of identifying and communicating site-specific hazards and controls.
- Train workers in hazards identified.

CONTROL POINT: Design

b. Chemical Hazards.

(1) *Waste Material Exposure (Excavation and Transport).*
Description. Workers may be exposed to chemicals during excavation, transport, or handling of contaminated materials. Dry soils may generate airborne dusts contaminated with toxic materials, including and in addition to those contaminants being treated (e.g., respirable quartz, pesticides, etc.).

Control. Controls for waste material exposure include:

- Train the workers in the hazards, engineering controls, personal protective equipment, and good personal hygiene practices to reduce potential exposure.
- Routinely wet material and dirt/gravel travel routes to prevent airborne dust generation. Cover all excavated material during transport.
- Use appropriate respiratory protective equipment as determined from the result of adequate air monitoring, e.g., air-purifying respirators with N, R or P100 filters for particulates; organic vapor cartridges for organic vapors and some acid gases, or combination filter/cartridges for dual protection.

CONTROL POINT: Operations

(2) *Process and Waste Products.*
Description. During operation of the thermal desorption unit, workers may be exposed to contaminants or thermal desorption chemicals and other byproducts or conditions such as oxygen deficient inerting gases, methane, H_2S, CO, airborne toxic metals, metal acetates, mercury, lead, and chlorine. Subunits within the system that utilize bulk chemical or sludge additives in conjunction with exhaust gas wet scrubbers, pre-clarifier mixing tanks, filter press pre-coat tanks, or surge tanks, may present significant exposure potentials, both when replenishing the chemicals and when performing routine maintenance on the units.

Control. Controls for waste products include:

- Train all workers involved in both the operation and maintenance of the thermal desorption system. Training shall include hazards related to the generation, transport, and treatment of byproducts, and bulk chemical additives.
- Characterize and classify wastes to be treated prior to desorption. Feed only those waste materials compatible with the process into the unit.
- Design off-gas treatment to control generation and release of toxic materials. Design engineering controls for the system to prevent or minimize the gen-

eration or release of toxic materials into the breathing zone of the workers. Engineering controls could include negative air throughout the treatment system, dust misting systems at strategic points throughout the system, real-time monitors with alarms, and contaminant-specific monitoring badges.

- Locate, install, and maintain emergency fire fighting equipment, and eye-wash and emergency showers at critical points throughout the system. (See ANSI Z358.1 – 1998.)
- Assess workplace and identify appropriate personal protective equipment (PPE) that includes an evaluation of contaminants, treatment byproducts, and process-related hazards. Use approved PPE, such as thermal protective gear, safety glasses, face shields, protective gloves, air-supplied respirators or air-purifying respirators with appropriate filters/cartridges and air emissions controls.

CONTROL POINT: Design, Operations

(3) *Exhaust Vapors*.
Description. Workers may be exposed via inhalation during the thermal desorption process. Because some chemical contaminants, such as fuel oils, are not completely destroyed in the process, they may be discharged via the exhaust stack and in certain atmospheric conditions may affect the work area.

Control. Controls for exhaust vapors include:

- Gather exhaust vapors for further processing in an off-gas treatment unit (e.g., vapor carbon beds, incinerators, thermal oxidizers, or gas scrubbing towers). Fugitive emissions are possible if systems are not designed to address these issues.
- Verify that systems are operating at designed operating pressures, less than atmospheric pressures, to eliminate fugitive emissions.

CONTROL POINT: Design, Operations

(4) *Toxic Dust/Respirable Quartz Hazard*.
Description. Depending on soil types, exposure to respirable quartz may be a hazard during the excavation and soil-handling phase of the process. Consult geology staff to confirm the presence of a respirable quartz hazard (e.g., to determine if soil types are likely to be rich in respirable quartz). As an aid in determining respirable quartz exposure potential, sample and analyze site soils for fines content by ASTM D422 – 2002: "Standard Test Method for Particle Size Analysis of Soils" followed by analysis of the fines by X-ray diffraction to determine crystalline quartz content.

Control. Controls for respirable quartz include:

- Wet the soil periodically with water or amended water to minimize worker exposure. Consult 29 CFR 1910.1000, Table Z-3, to calculate acceptable respirable dust concentrations based on percent silica in the quartz.

- Use respiratory protection, such as an air-purifying respirator equipped with N, R or P100 particulate air filters.
- Train workers in the potential inhalation hazards associated with crystalline silica exposures.

CONTROL POINT: Design, Construction, Operations

c. Radiological Hazards.

Radioactive Devices.
Description. Fire and smoke detection devices and other process monitors and switches may contain radioactive devices potentially exposing workers through lack of identification or mishandling.

Control. Controls for inadvertent handling or exposure to radioactive devices include:

- Workers should be prevented from and warned against tampering with the devices.
- The location of the devices should be recorded so as to safely retrieve and dispose of them in case of a system failure and equipment replacement.

CONTROL POINT: Design, Operations and Maintenance

d. Biological Hazards.

Opportunistic Insects and Animals.
Description. For all sites but especially in cooler climates, opportunistic insects or animals can nest in and around warm process equipment. Vermin, insect, and arthropod control measures should be considered in any design.

Control. Controls of opportunistic insect and animals include:

- Electrical cabinets and other infrequently opened enclosures should be opened carefully and checked for black widow and brown recluse spiders, and evidence of rodents. As rodents can cause damage to electrical cables, all wiring should be inspected regularly.
- Ensure all storage is off the ground, palleted, and kept dry. Damp areas attract scorpions, rodents, and the snakes that eat them.
- Design ceiling corners and other high areas to discourage nesting by swallows, pigeons, and other birds. Birds are carriers of diseases, especially in their droppings, which can foul cranes and process equipment.

CONTROL POINT: Design, Operations and Maintenance